University Currents

A Newsletter For and About the University Nuclear Engineering and Science Community

U. S. Department of Energy *Summer 2005*

Departing Moments: Bill Magwood Visits WNSA and SCSU

On May 17, 2005, Bill Magwood resigned from his position as Director of the Office of Nuclear Energy, Science and Technology, a position he had held for seven years. Secretary Bodman named Shane Johnson as Acting Director. In the two weeks prior to his departure, Director Magwood made visits to the Western Nuclear Science Alliance (WNSA) meeting in Corvallis, Oregon (one of six Innovations in Nuclear Infrastructure and Education consortia); the Idaho National Laboratory; and South Carolina State University in Orangeburg, South Carolina.

During the visit to WNSA on May 3, 2005, Mr. Magwood was honored as the Distinguished Lecturer by WNSA and the Department of Nuclear Engineering and Radiation Health Physics in Oregon State's (OSU) College of Engineering. The Western Alliance consortia, headed by OSU, is a collaboration of West Coast universities, national laboratories, and private industry in support of nuclear science and engineering education, research and development.

Mr. Magwood's visit to Corvallis was highlighted by the presentation of a plaque (pictured below) on behalf of the Nuclear Engineering Department Heads Organization (NEDHO) and the Test, Research, and Training Reactor (TRTR) National Organization honoring him for his work in leading the Nation in a new consideration of nuclear technology as a means to address our energy needs without emissions.

(continued on page 15)

Bill Magwood with Steve Binney and Jose Reyes at OSU

NEDHO/TRTR Plaque for Director Magwood

Western Nuclear Science Alliance Members and Guests

ANS Programs Support Universities and University Students

American Nuclear Society programs make a significant contribution to university nuclear engineering departments and nuclear engineering students. These programs include a mixture of public outreach activities, active Student Sections, scholarships, NEED grants, and more.

ANS has 34 active U.S. Student Sections that provide a viable and visible presence on campuses around the country. Each Section provides a variety of activities that help nuclear engineering students develop a relationship with current and future nuclear professionals, while honing a variety of skills that complement their academic preparation for professional life. Sections have recently been added at the United States Military Academy at West Point (2004) and the University of South Carolina (2005).

ANS National Student Membership now numbers approximately 1,400.

ANS scholarships are an important part of the Society's support for future professionals. Sixty-seven scholarships, totaling $178,000, have been awarded to graduate and undergraduate students for the 2005-2006 academic year. In addition, the first ANS Incoming Freshman Scholarships were awarded to three graduating high school students for the 2005-2006 academic year.

Some of the 59 students at the Missouri-Rolla High School Nuclear Engineering Summer Camp working on their project.

ANS outreach activities help stimulate interest in nuclear science and technology and interest in nuclear engineering as a career. In 2004, through funding from the DOE Office of Nuclear Energy, Science and Technology, ANS headquarters supported a total of 101 outreach events including teacher workshops, scout programs, career fairs, science fairs, and classroom visits. Eleven Student Sections participated in a total of 35 outreach events that reached 4750 students in high schools and middle schools in 10 states. In the first six months of 2005, nine sections were active in conducting 14 outreach events.

Through its NEED program, in 2004 and so far in 2005, ANS has provided 9 grants to Universities to help with recruitment of diversity candidates for engineering programs. In June 2005, ANS approved a Position Statement on Diversity in the Nuclear Profession.

In June 2005, ANS added a Young Members Group to its structure to help it better meet the needs of young professionals once they leave the university and enter the workforce.

Missouri-Rolla High School Nuclear Engineering Summer Camp students sponsored by the University with the assistance of the American Nuclear Society student section.

Energy Secretary Bodman, Idaho Gov. Kempthorne Attend Opening of New Center for Advanced Energy Studies

The Center for Advanced Energy Studies (CAES) was inaugurated on Wednesday, June 1, by Energy Secretary Samuel Bodman, Idaho Gov. Dirk Kempthorne, and a host of other dignitaries. The event marked the start of CAES's programmatic activities. CAES is a new center for advanced energy research, technology, and engineering education seeking to develop innovative ways to meet America's future energy needs. CAES will place primary focus on nuclear energy technology development.

At the event in Idaho Falls, Secretary Bodman said, "Technology is the answer to meeting our growing energy needs. By developing programs like CAES, we are investing in the next generation of scientists and engineers who could hold the key to unlocking our energy future. These should be very exciting times for what you do. You will be instrumental in reviving nuclear power." He also noted that CAES's scientific research is of great importance to the nation.

Energy Secretary Samuel Bodman and Idaho Governor Dirk Kempthorne welcome the beginning of the CAES program activities

Gov. Kempthorne, said "I am especially pleased that this important research will be conducted in Idaho. The Idaho National Laboratory, as the nation's leading laboratory for nuclear energy research, makes this the perfect place for this important work." CAES is a collaborative venture among the Department of Energy; the state of Idaho; a consortium of three Idaho research universities (Idaho State University, University of Idaho, Boise State University); a National University Consortium led by MIT with the Ohio State University, Oregon State University, North Carolina State University and the University of New Mexico; Battelle Energy Alliance; and Idaho National Laboratory. A new Idaho State University BS degree in Nuclear Engineering, which includes internships on the INL site, will start as a pilot program with six juniors in the fall 2005. CAES is expected to assume nonprofit status as an independent center or "joint institute" by 2010, and will play a key role in United States and global energy research programs.

CAES Director Leonard Bond, right, welcomed the group and introduced Gov. Kempthorne. Kempthorne's support was instrumental in the founding of CAES and its colocation with INL.

From left, DOE-ID Manager, Beth Sellers; Gov. Dirk Kempthorne; Secretary Bodman; INL Laboratory Director, John Grossenbacher; and CAES Director, Leonard Bond. These five were key in achieving the partnership between DOE-ID, INL, eight major universities, and private industry that forms the foundation for CAES.

University of Michigan Faculty Teach a Course on Reactor Safety Analysis at Shanghai Jiao Tong University

Professors John C. Lee and William R. Martin recently taught a two credit version of Michigan's three credit course, Reactor Safety Analysis, to an enthusiastic class of undergraduate and graduate students in the Department of Nuclear Science and System Engineering (NSSE) within the School of Mechanical Engineering at Shanghai Jiao Tong University (SJTU). The course had to be offered on an accelerated basis due to the academic schedules of SJTU and Michigan, and was taught over a span of three weeks in May 2005. Nevertheless, 35 students attended the course, 27 for credit, and comments from both the students and faculty were very positive. The course included a comprehensive treatment of modern reactor safety analysis principles and methodology, including an emphasis on probabilistic risk assessment techniques for modern nuclear power plants. SJTU is one of the premier universities in China and its NSSE Department is growing rapidly, partly a consequence of the decision by the Chinese government to rely heavily on nuclear power to meet a substantial fraction of its electricity demands for the foreseeable future. The photographs were taken during a lecture by Professor Martin on the Mihang Campus at SJTU.

Students taking the University of Michigan's Reactor Safety Analysis" course at Shanghai's School of Mechanical Engineering at Shanghai Jiao Tong University

Fuel Cladding: Gadolinium or Boron?

After two years of study, engineering physics researchers learned enough about gadolinium, a material commonly used to "eat" neutrons during a reactor power-up, that they crossed it off their list of candidates for coating the zirconium tubes that hold a reactor's fuel.

During power-up, the uranium-dioxide fuel pellets emit a blast of neutrons that pass through the zirconium tubes' walls. Boron or gadolinium mixed with the pellets help diminish the neutron blast; however, the mixing process is costly, heavily regulated, and detrimental to the fuel's efficiency.

Working with Westinghouse Corporation and Sandia National Laboratories, Senior Scientist Kumar Sridharan and Associate Scientist Mark Anderson tested a method to take the boron or gadolinium out of the fuel pellets and place it into the outer surface of the zirconium tubes.

The two successfully alloyed the gadolinium and boron onto zirconium using a high-energy ion blast. When the researchers tested each material to see how it responded under reactor-like conditions, the gadolinium-alloyed zirconium corroded substantially.

The boron on zirconium, however, passed with flying colors, says Sridharan. "Boron did not corrode at all in the autoclave tests," he says. "So that's a real success story."

With extended funding via the U.S. Department of Energy's Nuclear Energy Education Research program, he and Assistant Professor Todd Allen will expand the substrate material from zirconium to ferritic martensitic and austenitic steels. "Another addition to the work will be the radiation testing," says Sridharan, "because after all, we want to see how these alloyed layers behave under radiation."

With collaborators at Idaho National Laboratory, the two have started radiation-testing the boron-alloyed zirconium at the laboratory's reactor facilities.

Virtual Reality Workshop Showcases New Tools

Seeing is Believing!

That's the consensus of participants in the workshop, "Visualization to Support Human Decision-Making: Technology Demonstrations and Application Discussions held at the University of Illinois at Urbana-Champaign." The workshop, co-sponsored by the Department of Nuclear, Plasma, and Radiological Engineering and the Electric Power Research Institute (EPRI), brought together Illinois faculty and students with nuclear utility executives and industry experts from around the world.

Supported by the Department of Energy, the Department of Nuclear, Plasma, and Radiological Engineering at Illinois is developing a Virtual Reality (VR) laboratory to perform research and development concerned with current and next generation nuclear power plants and research reactors.

"EPRI is conducting research and developing demonstrations of visualization technology as it may be applied to the nuclear power generation industry," explained Professor Rizwan Uddin, one of the event organizers. "Our visualization research program includes a virtual model to help minimize radiation dosage, and development of tools to facilitate modeling and simulation of virtual nuclear power plants."

For the meeting, these virtual models were brought to life using two "immersion technologies" at the Beckman Institute for Advanced Science and Technology. Both the CAVE™ (Cave Automatic Virtual Environment), CUBE™ and VisBox™ systems have audio and visual stereophonic capabilities which allow researchers to interact with their data in a virtual environment.

In addition to showcasing the tools developed at Illinois, representatives from the Halden Reactor Project in Norway demonstrated several successful VR products and applications they have developed.

"The products we brought here are related to virtual control rooms and radiation visualization models," stated Michael Louka, Deputy Division Head, Visual Interface Technologies at the Halden Virtual Reality Centre (HVRC).

Among the products HVRC demonstrated was CREATE (Control room layout and workplace design), a VR system used to support modernization of the control room in the Swedish Oskarshamn nuclear power plant. VR dose consists of a set of VR tools developed for decommissioning Japan's Fugen nuclear power plant. They support training, planning, and administration of the decommissioning process, and can be used for outage planning purposes. HVRC also demonstrated a virtual reality-based refueling simulator utilizing VR technology for training refueling specialists at the Leningrad Nuclear Power Plant.

"Since this a new, commercial product, we were interested in getting feedback," Louka added. "It was also a nice opportunity to see our product within an immersive system like the CAVE facilities. We have a 3D system, but nothing that surrounds you like the CAVE."

According to Uddin, anything that is available in CAD (computer-aided design) is available in 3D, and can easily be converted to the university's systems.

EPRI's Joe Naser and Lew Hanes opened the workshop with an overview of the organization's visualization research program. They detailed a project to develop interactive virtual valves intended to support maintenance technician training, rehearsal, and job support. During the hands-on sessions, attendees were able to work with two virtual valve models on conventional PC's.

Also representing the international community, Dominique Pirus from Electricité de France (EdF), who described a wearable computer research project—a device which may provide a person (e.g., maintenance technician, HP technician) with 2.5D virtual models to support work performance in the plant.

"Having a strong nuclear engineering program and the virtual-reality technology available to demonstrate these tools reinforces the university's leadership position in this critical industry," Uddin added. "Although the numbers of individuals involved in a workshop like this are not very large, the effects of this work will likely be felt around the world."

Students and faculty at Beckman Institute for Advanced Science and Technology

High School Students Nuked in Wisconsin

Thirteen AP Chemistry students from La Crosse's (WI) Central High School visited the University of Wisconsin-La Crosse (UW-L) in March. They came to the University's Radiation Center to conduct two nuclear science experiments. The field trip was set up by Central chemistry teacher Annie Mach and UW-L chemistry faculty Jeff Bryan. "We're fortunate to be able do these experiments," said Ms. Mach, "very few high school students have this opportunity."

The students investigated the effect of various forms of shielding on different types of ionizing radiation, and also determined the half-life of vanadium-52. The ^{52}V was generated in the center's neutron howitzer. "The students were well prepared and asked some very intelligent questions," noted Bryan, "they were clearly thrilled to be here." One student remarked, "this makes me really excited about going to college." Another thought that he might change his future college major to nuclear science.

It was the first such visit by Central High School, and was based on an existing six-year collaboration between Onalaska High School and UW-L. It is a great example of community outreach taking advantage of some of UW-L's unique capabilities.

Central High School students Casey Sleznikow, Dino Kozidas, John Harned, and Tim Rhorer investigate radioactivity at UW-L's Radiation Center.

Central High School students Jennifer Hildahl and Hannah Smith investigate radioactivity at UW-L's Radiation Center.

UNLV: Enrollment Growth in Nuclear

Enrollment at the University of Nevada, Las Vegas, (UNLV) is expected to top 30,000 when fall 2005 begins, and UNLV has recently joined the ranks of the top 50 U.S. research universities, due in large part to one of the largest and fastest growing nuclear energy, science, and technology research and education programs in the U.S. These relatively new programs have already grown to include more than 100 faculty members, students, and research staff spread across many departments in several colleges and research centers. In addition, two new graduate degree programs that will support nuclear research. They are a M.S. in Materials and Nuclear Engineering in the Mechanical Engineering Department (College of Engineering) and a Ph.D. in Radiochemistry that is an interdisciplinary program of the Chemistry (College of Sciences) and the Health Physics (School of Health and Human Sciences) Departments.

Nuclear research programs, which are funded at more than $10 million annually through the Harry Reid Center for Environmental Studies, include two major programs of the U.S. Department of Energy: the Advanced Fuel Cycle Initiative (AFCI, $7 M FY 2005, which includes both the UNLV Transmutation Research Program and the Deep-burn

What's Happening in the Department of Nuclear Engineering and Radiological Sciences at the University of Michigan

The Department of Nuclear Engineering and Radiological Sciences (NERS) at the University of Michigan has seen a number of changes over the past few years. Unfortunately, these changes included the closing of the Ford Nuclear Reactor in the summer of 2003, an event that was staunchly opposed by the NERS faculty, ultimately to no avail. NERS has since moved on, making use of the Midland Dow nuclear reactor and purchasing a neutron generator with funds provided by DoE and the University of Michigan to ensure that NERS students continue to have "neutrons" in their curriculum. In addition, NERS is enjoying a banner year in undergraduate and graduate recruiting, reflecting to some extent the national trends in nuclear engineering enrollment. The current enrollments are 97 undergraduate students (counting three years) and 88 graduate students, including 28 new graduate students expected this fall. The Department has 14 full-time faculty, with concentrations in (1) fission systems and radiation transport, (2) plasmas and fusion, (3) materials, (4) radiation measurements and imaging, and (5) radiation safety, environmental sciences, and medical physics (REM).

Cooley Building, Home of the Department of Nuclear Energy and Radiological Sciences

A Few Seniors Celebrating the End of a Footrace at the College of Engineering Reflecting Pool Adjacent to the Cooley Building

Research and Education Program

Gas Cooled Reactor Project), and the Nuclear Hydrogen Initiative (NHI, $4 M FY 2005). These nuclear education and research programs at UNLV, which have a primary focus on management of high-level waste (meaning closing the commercial nuclear fuel cycle via recycling and transmutation of waste), have supported the hiring of ten new faculty and research staff and the construction of ten lab facilities on campus. Among these are Transmission Electron Microscopy, several Radiochemistry, Electron Microanalysis and Imaging, Lead-bismuth Eutectic, and Materials Performance Laboratories. UNLV research collaborations also include an impressive list of world-class research institutions: UC Berkeley, the Idaho Accelerator Center at ISU, and MIT; General Atomics and Ceramatec, Inc.; Idaho, Los Alamos, Sandia, Argonne, Oak Ridge, and Brookhaven National Laboratories; the Khlopin Radium Institute and the Institute for Physics and Power Engineering in Russia; and Ben Gurion University of the Negev in Israel. Although UNLV is still establishing its reputation as a research university, UNLV nuclear research students have received top awards at student and topical conferences, and 30 have graduated with M.S. degrees, and 2 with Ph.D's.

Continued Excitement at

The Department of Nuclear Engineering and Radiation Health Physics in Oregon State University's College of Engineering has had an exciting year. In November U.S. Secretary of Energy Spencer Abraham announced the Idaho National Laboratory contract award to the Battelle Energy Alliance (BEA). As a member of the consortium of universities involved in the BEA, OSU is looking forward to continuing research on the forefront of nuclear engineering.

Universities involved in this alliance, MIT, NC State, Ohio State, Oregon State, University of New Mexico, and the Idaho Universities, will conduct regional outreach and take the mission of the Idaho National Laboratory to other universities.

Focus areas for university involvement in the INL include: Advanced Nuclear Energy Systems at MIT; Modeling and Simulation at North Carolina State; I&C and Safety of Advanced Systems at Ohio State; Thermal Hydraulics and Safety at Oregon State; Space Nuclear Power at University of New Mexico, and Nuclear Fuel Cycle at the Idaho Universities.

This fall, tests done in ATHRL, along with much other work in a massive, international project, led to the final approval by the Nuclear Regulatory Commission of the AP 1000 Generation III-plus, an advanced nuclear reactor design from Westinghouse available for international and domestic orders.

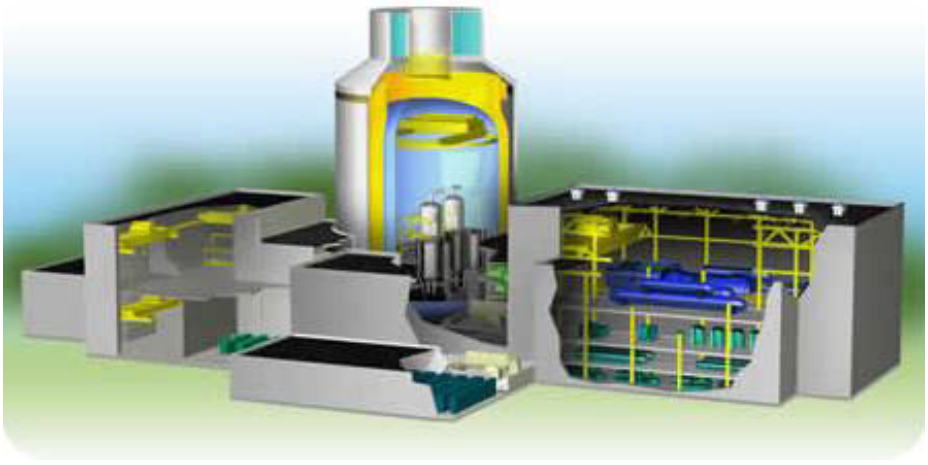
For its work in this field, ATHRL, in collaboration with The Industrial Company, received two awards from the Associated Builders and Contractors. The awards recognize their achievements in upgrading the testing facility from the AP600 design to the AP1000 design. Built in one-quarter scale in the test laboratory, and tested repeatedly under varying conditions. The recent major upgrade to the facility involved construction and design of new electrical, mechanical, and pipe components, new data acquisition hardware, tracking instrumentation, and state of the art computer hardware and software.

"OSU is very proud of the important research we contributed to assist Westinghouse and the Nuclear Regulatory Commission in their determination that this reactor design concept meets the design requirements of reducing costs and enhancing safety," said Andrew Klein, professor in the Department and former Department Head. Leaders of the OSU Thermal Hydraulics and Reactor Safety team include José Reyes, Qiao Wu, Brian Woods, John Groome, Teresa Culver, Abd Lafi, and John Hopson, as well as both graduate and undergraduate students.

In February ATHRL was expanded to include the new Academic Center of Excellence in Thermal Fluids Heat Transfer. Within days of the announcement seven proposal requests were received, including work on the High Temperature Modular Reactor design which will produce hydrogen.

In other reactor news, José Reyes presented the OSU/INL and Nextant-Bechtel Design for a Multi-Application Small Light Water Reactor to the United Nations for a new category of reactors without on-site refueling. He presented while on a year-long loan to the IAEA. During that time Reyes worked with the Nuclear Power Technology Development Sub-Program and in December hosted a Research Coordination Meeting to which NERHP Department Assistant Professor Brain Woods traveled.

The meeting, held at IAEA headquarters in Vienna, Austria, was attended by representatives from 14 countries and was organized to work towards developing a technical document on natural circulation phenomena, modeling, and reliability of passive systems that utilize natural circulation.



One of the meeting speakers was Woods who communicated the research from OSU, done in conjunction with Associate Professor Qiao Wu, and the MASLWR (Multi-Application Small Light Water Reactor) testing facility. An investigation of natural circulation and passive cooling in an Integrated Reactor, the work studied flow stability, natural circulation in an integral system, and passive safety tests.

"It was very exciting to be part of this international effort and to learn of the

Oregon State University

different ways that nations are approaching their future energy needs," said Woods.

In other Departmental research news, in January Associate Professor Kathryn Higley and a group of graduate students was awarded a contract from Bechtel-Hanford to help support the initial stages of a CERCLA risk assessment for the Columbia River due to releases from the Hanford Site. Working with Kurt Peters, head of OSU's Native American Collaborative Institute, the team will acquire and interpret environmental data regarding the Columbia River, from below McNary Dam to above Bonneville Dam.

The initial task of the review is to compile, review, and evaluate existing information on Hanford Site containment data so as to form a validated informational database that will support meaningful risk assessments. The main goal in involving university groups like the one from OSU is to utilize university research expertise, and the unbiased and motivated work from graduate students.

Also in January, Alena Paulenova, Assistant Professor of Radiochemistry, was awarded a NERI Grant for DOE's Spent Fuel Cycle Initiative. Studying the Plutonium Chemistry in UREX+ Separations Technology, "researchers will identify the plutonium species formed in aqueous and organic extraction phases and the interface between phases" to address the disposal of commercial nuclear reactor fuel and to improve the performance of the geologic repository.

Lastly two students in the ANS student chapter were awarded a NEED grant for the recruitment of underrepresented students in the nuclear sciences. Kati Gray and Sarah Kleeb, winners of a public policy and outreach award at last years ANS student conference, received funding under the Nuclear Engineering Education for the Disadvantaged.

"In applying for the grant we said we would organize a Girl Scout version of the Boy Scout Atomic Merit Badge, buy supplies to make outreach kits, and purchase a cloud chamber," said Gray. Currently the Girl Scouts don't have anything like the Boy Scout badge and if a Girl Scout wants to pursue atomic energy she would have to design the badge and requirements herself. Gray and Kleeb hope to get more Girl Scouts involved by removing this hurdle.

Said Kleeb, "We are really excited to be awarded with this grant, and it will be great to be able to get more involved with the local community and to help these girls see the great possibilities that await them in engineering."

Glenn Murphy Award

Dr. Sheldon Landsberger Director of the Nuclear Engineering Teaching Lab and Coordinator of the Nuclear and Radiation Engineering Program at the University of Texas at Austin, was the recipient of the Glenn Murphy Award given by the Nuclear and Radiological Division of the American Society of Engineering Education. This award, endowed by the Friends of Glenn Murphy, the Edison Electric Institute and Iowa State University, is made annually to a distinguished nuclear engineering educator in recognition of notable professional contributions to the teaching of undergraduate and/or graduate nuclear engineering students. The award was given at the annual American Society of Engineering Education meeting in Portland, Oregon in June 2005.

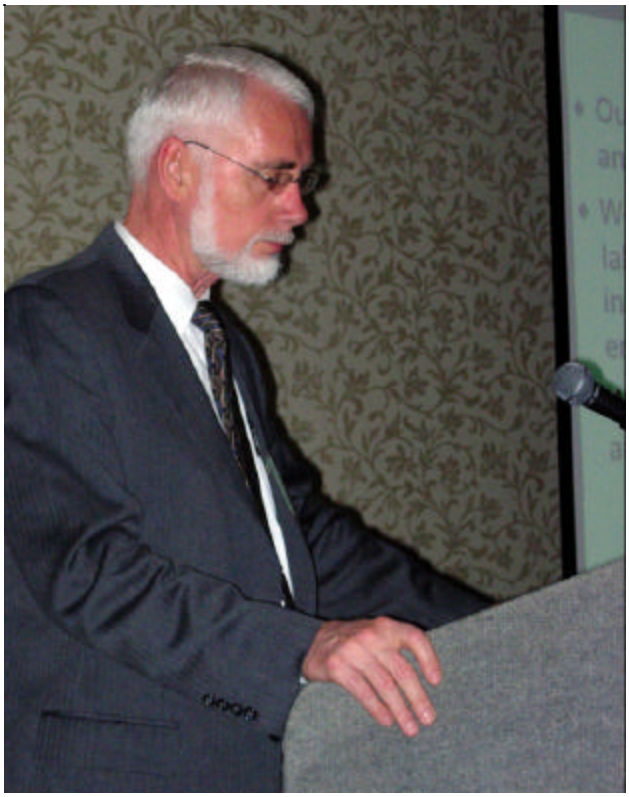
Office of Nuclear Energy, Science and Technology Hosts Workshop for University Researchers

The Nuclear Energy Research Initiative (NERI) took on a new focus in 2004, the meaningful involvement of US universities in the Office of Nuclear Energy, Science and Technology's (NE) principal research programs. In FY 2005, the program awarded 35 new research projects, engaged 26 U.S. universities, and provided $21M in funding for three-year research project periods.

NE hosted its second two-day Advanced Reactor, Fuel Cycle, and Energy Products Workshop for Universities on June 16 and 17 in Rockville, Maryland, and 76 university faculty and staff, representing 42 universities, attended the workshop. The 42 universities included 17 universities that had not attended the 2004 workshop.

The June 2005 workshop provided a thorough overview of the FY06 priorities of the three main programs that are funded through the NERI program:

- Generation IV (Gen IV)
- Advanced Fuel Cycle Initiative (AFCI)
- Nuclear Hydrogen Initiative (NHI)



Rob Versluis presented the keynote address at the June Advanced Reactor, Fuel Cycle, and Energy Products Workshop for Universities. NE plans to invest $10M in FY06 funds in competitive university research.

Program management expects FY06 funding to total $10M with $4M coming from the AFCI program, $4M coming from Gen IV, and $2M coming from the NHI. The NERI program encourages integrated teaming relationships with the DOE and its national laboratories

The program's goal is to sustain and broaden the benefits of clean, safe, and secure nuclear energy. To do so, the program invests in industry, the national laboratories, and the university community to overcome institutional and technological barriers to reliance on nuclear energy. Rob Versluis presented the keynote address. Versluis noted that there is a clear correlation between government's investment in nuclear programs and the growth of nuclear programs at universities.

The NERI solicitation was issued in June. Plans are for applications to be due in August and results announced in November. The program expects awards will be completed in January 2006. The solicitation can be found at the web sites listed below:

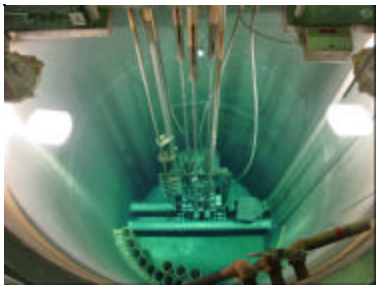
- http:e-center.doe.gov
- http://www.fedbizopps.gov
- http://www.nuclear.gov

Upgrade of the Maryland University Training Reactor (MUTR) for Nuclear Health Medicine

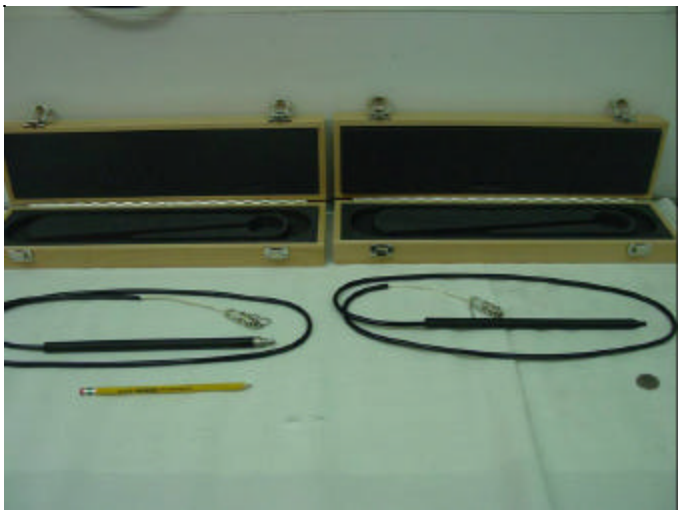
Through funding provided by the Innovations in Nuclear Infrastructure and Education (INIE) and collaboration with the Georgia Institute of Technology, modifications have been made to the Maryland University Training Reactor (MUTR), which will facilitate its use as a key instrument in the research of nuclear health medicine.

In an effort to attain an ideal neutron to gamma-ray ratio of 3:2 within the reactor beam port for simultaneous high and low-LET irradiation, a pair of ion chamber detectors was used to precisely characterize the beam passing through the samples. The pair of ion chambers, one made of magnesium to detect only gamma-rays and the other of a tissue-equivalent plastic that detects both gamma-rays and neutrons, are coupled to provide both total and individual dose rates. The original detected ratio was 4:7 and a new aluminum plug filled with lead was designed and fabricated to house the samples near the core, blocking gamma-rays produced within the water tank while maintaining a high neutron flux. The pair of ion chamber detectors was again utilized to characterize the beam, which revealed an improved ratio of 3:4. Currently, the reactor is being modeled by Monte Carlo N-Particle in order to calculate the thickness of tungsten required to line the aluminum/lead plug that will yield the desired neutron to gamma-ray ratio. In addition to this, the previously unused thermal column is being opened to provide the thermalized neutrons required for research involving enhanced boron neutron capture therapy of prostate cancer cells which have absorbed a novel boron-containing cholesteryl carborane ester compound.

Maryland University Training Reactor (MUTR)



MUTR Core



Ion Chamber Detectors

Aluminum Plug

Rensselaer Polytechnic Institute Updates

Student Conference 2006

- RPI's student section of the American Nuclear Society was awarded the bid for the 2006 ANS National Student Conference. The Conference committee, chaired by rising Senior Rian Bahran, is looking forward to welcoming approximately 300 visitors to Troy next Spring.
- The 2005 Nuclear Engineering Student Delegation to Washington, D.C., consisting of 11 students from 9 different universities, visited the nation's capital July 25-27, 2005, to lobby lawmakers and policymakers on matters of interest to Nuclear Engineering students from across the country. This year's delegation was chaired by RPI student Rian Bahran, and co-chaired by RPI student Paul Kollath-Romano. A detailed report from their delegation will be released later this Summer.

Secretary of Energy Bodman with the Nuclear Engineering Student Delegation (from left: Paul Kollath-Romano, RPI; Krystina Tack, Oregon State; Wayne Lytle, Illinois; Katherine Gray, Oregon State; Adam Nelson, Penn State; Whitney Raas, MIT; Secretary Bodman; Rian Bahran, RPI; Jason Hollern, Ohio State; Jill Rydalch, ISU; and Leah Spradley, Vanderbilt)

Faculty News

- Richard T. Lahey, Jr. has been awarded an Alexander von Humboldt Senior Scientist Fellowship, one of the most prestigious honors given to senior researchers around the world. With the fellowship, he plans to spend a year conducting research at the German National Nuclear Energy Laboratory in Karlsrube, Germany.

- Researchers at Rensselaer Polytechnic Institute and Ben-Gurion University in Israel have published results of a new experiment that found water molecules are made up of two hydrogen atoms and one oxygen atom, even during very short time intervals. The results dispute previous claims made by another research group suggesting a change in the chemical formula of water. The members of the Rensselaer research team were: Robert Block, director of the Gaerttner LINAC Laboratory and professor emeritus of nuclear engineering; Raymond Moreh, visiting scholar in Rensselaer's nuclear engineering and engineering physics program and professor of physics at Ben-Gurion University; Yaron Danon, assistant professor of nuclear engineering; and Matthew Neuman, senior undergraduate student in nuclear engineering. The research findings were published in *Physical Review Letters* on May 13 in a paper titled "Search for Anomalous Scattering of keV Neutrons from H_2O-D_2O Mixtures."

John Gutteridge, Director of University Programs, with the student delegation

Wisconsin Research -- Supercritical Water Reactor

Using some current nuclear reactor materials in the high-temperature, high-pressure reactors of tomorrow is a little like trying to cook a steak with a flamethrower. The operating environments are so extreme that both the reactor materials – and your dinner – would fail.

A U.S. Department of Energy (DOE) initiative, Generation IV, calls for new nuclear energy systems that are economical, safe, and reliable and could be commercially deployed by 2030. One of the reactor concepts under the plan is a supercritical water reactor (SCWR), which combines high pressure and high temperatures to convert water into its supercritical state. This super-heated water drives a turbine and a generator coverts the heat into electricity.

"The main reason for using supercritical water is that you operate at higher temperatures and pressures and you get better system efficiency," says Assistant Professor Todd Allen. "For the same amount of heat out of your fuel, you translate that into more electricity out of your turbine. The challenge is, by going up in temperature and pressure, it's a more aggressive environment, so the materials challenges are more severe than they would be for today's boiling water reactor."

With funding from the DOE Office of Nuclear Energy, Science and Technology, Allen and Senior Scientist Kumar Sridharan are studying some of the materials challenges associated with fuel containment and other components for future SCWRs.

In the temperature, radiation and pressure range that an SCWR operates, says Allen, there's no obvious first-choice material. Initially, the researchers are evaluating three classes of materials -- austenitic steels, ferritic martensitic steels, and nickel-based alloys. Ferritic martensitic steels oxidize the most but are very stable against radiation; the oxide layer on austenitic steels tends to be thinner, but the nickel in these alloys can lead to transmutation products. Over long periods, the oxides can flake and fall off. "If it falls off, then it makes it easier for you to corrode new metal," says Allen. "And ultimately, what we're trying to do is protect as much of the original alloy as possible."

They also learned that nickel-based alloys don't corrode much; however, when exposed to radiation, they generally become brittle and fail. Given that information, the two are focusing on ferritic martensitic steels and austenitic steels. "We're trying to find ways to keep the oxide layer on the ferritic martensitic steels stable to make it thinner; the austenitic steels we want to keep the oxide layer thin like it is, but make it more stable," says Allen.

The researchers have tested materials treated with nanometer-sized yttria-titanium oxide particles to improve their strength. Including the oxide particles dropped the corrosion rate by about half based compared with a comparable, non-treated material. In addition, they are attempting to implant a variety of elements into the surfaces of the steels and to dramatically change their surface structure to understand what characteristics make them work well.

In addition, they treated the austenitic steel alloy 800-H to change the orientation of its grains relative to each other so that the energy of the boundaries was much lower. "That treatment really improved the stability of the oxide in a 1,000-hour test," says Allen.

So that they can change both a material's chemical composition and its physical nature, Sridharan and Allen recently bought two pieces of equipment for their laboratory. With an arc melter, they can make their own test alloys; with a shot peen, which essentially shoots little balls at a surface, they can study how surface treatments might change how materials corrode and stress crack. "It puts the surface under compression, and when it does that, cracks don't open up because stress is trying to close the cracks," says Sridharan. "And this is just a guess, but it should also be able to change the grain orientation."

Ultimately, says Allen, they hope to find materials that have adequate corrosion resistance. "The stable materials form a thin, stable oxide that does not limit heat transfer too much, they don't stress-corrosion crack, and their response to radiation is adequate (meaning that they don't get brittle), and that they don't have unacceptable volume changes (some materials tend to swell up under radiation)," he says.

The materials he and Sridharan are studying for SCWRs also are candidates for other proposed Generation IV reactors, including lead-cooled and molten-salt reactors. In their new laboratory, a SCW corrosion cell, built by Associate Scientist Mark Anderson, came online in June; in the future, the lab also will include a pot system to study corrosion in the lead-cooled reactor concept and pot and loop systems to study corrosion and heat transfer for the molten-salt reactor concept. "We're the one place in the country that has the ability to look cross-system at how some of these materials perform," says Allen.

Moses -- Leading the Flock in Experimenting and e-Teaching

A guy who's fascinated by technology, Professor Greg Moses develops elaborate computer models that predict and then analyze the results of large-scale inertial-confinement fusion experiments.

Such experiments explore a method of producing fusion energy using high-powered laser beams that fire "photon bullets" at marble-sized fuel pellets at a billionth of a second a shot. Those bullets blow the pellets' surface off and super-compress the center. If everything goes according to plan, the center, which measures in the micron range, will become so dense and hot that the fuel will fuss, burn, and release energy—just like the fusion that occurs on the sun.

It all sounds simple, but there are a number of earthly factors that prevent this astronomical event from occurring as planned. "The physical phenomena that come into play here are shock waves; so-called laser-plasma interactions, which are electromagnetic theory and electromagnetic waves in reactions; and X-ray and atomic physics, because the plasmas get extremely hot and generate lots of X-rays, and the X-rays are the way that heat gets transferred from one part of the plasma to another," says Moses. "So understanding the details of that is really important."

In addition, everything is constantly moving. "If you can make all of this work, then theoretically, you could go on to make electricity," he says.

At UW-Madison, researchers are studying ways to design a reactor to do just that. Moses' radiation hydrodynamic simulations are designed to predict what will happen when you bombard the fuel pellets with laser shots. "The experiments themselves are very expensive and they're pulsed, which means that the experiment is over in a matter of nanoseconds," he says. "And so the diagnostics used to measure what's happening are largely indirect measurements."

In other words, in real life, it's impossible to measure every aspect—and one experiment might run around $1 million. So first Moses predicts what *should* happen, then researchers run the actual experiment at one of a half-dozen or so large national facilities. Finally, Moses conducts additional simulations that analyze the experimental data and determine if it occurred the way the researchers thought it would.

Advances in computing technology have made his job easier and the data more precise. "As computers get faster and faster, you can use more and more accurate physical models of various processes and be able to afford to do the computation," he says.

On the biggest computer, a calculation today might run for four days. Depending on his needs, Moses uses a parallel computer at the University of Rochester (New York), computers at Los Alamos National Laboratory, a supercomputer at the University of California-San Diego, or on campus, the department's PC cluster.

Moses has maintained an affiliation with the San Diego Supercomputer Center since the early 1980s, and in the mid 1990s, spent his sabbatical at the university. During that time, he helped to write a proposal for the center's renewal and became involved in the $1.5 million education and outreach component of the grant.

As a result, a vision he shared with Computer Sciences Professor Larry Lanweber to exploit the Internet as a medium for instructional technologies came to fruition.

Several years ago, Moses, Computer Sciences and Mathematics Professor John Strikwerda and researcher Mike Litzkow developed eTeach, an multimedia presentation authoring tool that enables faculty members on campus and elsewhere to integrate and synchronize video lectures, animated PowerPoint slides, web links and closed-captioning for online instruction. The elements appear in quadrants in a single window on the computer screen and students who view each multimedia lecture can pause, rewind or fast forward the video.

"It tries to appeal to different learning styles, because there's an ability to do a self-assessment as part of the presentation," says Moses. "With each question, there are buttons you can click that will take you back to the part of the lecture where the material was presented, so if you don't understand the questions, you can always go back and review it. Whereas, if you were in a live lecture, once it's done, it's done."

Today, he and other faculty members on campus and elsewhere use eTeach to maximize the in-class time they spend with their students—or in some cases, to teach them at a distance. In Moses' class, students view the lectures at their leisure as homework assignments, then come to a small-group laboratory session ready to work, interact with the instructors, and practice what they've learned. "The idea of the online presentations is to remove the characteristic that they're an 'event,' but rather that they're just another resource like a textbook," he says.

The software is one of a few such tools that include closed captioning and work with a screen reader. "It's gotten a lot of attention in the community of blind and deaf people," says Moses, who worked closely with staff at the college's Trace Research and Development Center and the

university's Division of Information Technology to build those features into eTeach.

It's not surprising that the man who uses computers to learn everything he possibly can about a fusion experiment might also use them to maximize the way his students learn. "While I started in a technology-push mode, I ended up in a different place—which is a much greater concern for student learning and using that to select appropriate technologies for doing that," he says.

In recognition of the way Moses has used eTeach to rethink the learning process and fundamentally change how he teaches his courses, the College of Engineering presented him with the first Harvey Spangler Award for Technology-Enhanced Instruction this May.

Engineering Physics Professor Greg Moses (right) and Mike Litzkow developed software that integrates closed-captioned video, PowerPoint notes and web links in a single window for online course delivery. With a video camera, lights and a simple black backdrop, Moses' office doubles as a studio for videotaping his lectures.

Departing Moments

(continued from cover page)

Mr. Magwood's contributions to the advancement of nuclear technology were recognized internationally with his election to Chairman of both the Generation IV International Forum and Paris-based Office of Economic Cooperation and Development Steering Committee on Nuclear Energy. Nationally, he helped in the development of the mission of the new Idaho National Laboratory, the Nation's premier laboratory for nuclear energy research, development and education.

Mr. Magwood's last trip as Director occurred on May 16, 2005, when he visited South Carolina State University (SCSU), where he was again honored at a luncheon for his work in bringing more minority institutions and students into the nuclear engineering and science discipline. Mr. Magwood's innovative program, University Partnerships, pairing a nuclear engineering school with a minority institution, was begun in 2000 as a pilot program at SCSU in concert with the University of Wisconsin. By the end of 2005, there will be eight partnerships with 17 institutions and approximately 60 students enrolled in the program from minority institutions and on their way to a degree in a nuclear-related field.

Mr. Magwood and Several Students and Guests Discussing the New Radiation Science Center at SCSU

Mr. Magwood with Dr. Andrew Hugine, President of South Carolina State University

International Nuclear Engineering Graduate Education Partnership Enters Seventh Year at Michigan

A unique international educational initiative in nuclear engineering is entering its seventh year at the University of Michigan. The initiative was started in 1999 as a partnership of three nuclear organizations: Westinghouse Electric Company, the China National Nuclear Corporation (CNNC), and the Department of Nuclear Engineering and Radiological Sciences (NERS) at the University of Michigan. Two CNNC employees are selected annually by Michigan NERS faculty from a list of prospective students in a company-wide competition organized by CNNC. The selected students, named Westinghouse-CNNC Fellows, pursue a one-year MS program in nuclear engineering at Michigan, culminating in a two-month summer practicum at Westinghouse. Westinghouse has provided generous financial support, totaling in excess of $750,000, for this initiative since its inception in 1999. Eleven CNNC employees will have graduated by September 2005 and returned to work at CNNC with a solid education in nuclear engineering with an emphasis on reactor safety. Two new Westinghouse-CNNC Fellows will start this fall at Michigan. A Westinghouse-CNNC-Michigan ceremony was organized this past fall in Beijing to honor the past graduates of this program and to thank the many people who have made this a very successful initiative.

Past and present China National Nuclear Corporation fellows, and Westinghouse and Mighican representatives at a ceremony in Bejing, China.

Important Dates to Remember

2005

- American Nuclear Society Meeting -- Washington, D.C. on November 13-17, 2005
- Nuclear Engineering Education Research Grant Solicitaiton -- issue date September 2005

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